Claims

I claim:

1. A method of analyzing a chemical analyte, said method comprising the steps of:

generating a fluctuation output signal in response to a plurality of frequency fluctuations in an oscillatory output signal of a SAW sensor, said fluctuations responsive to adsorption of molecules of said chemical analyte on a surface of said SAW sensor;

transforming said fluctuation output signal into an amplitude density signal, representative of the amplitude density of said frequency fluctuations; and

generating an analyte output signal representative of a total number n of said adsorbed molecules if said amplitude density signal corresponds to a theoretical amplitude density function P(r,n).

2. The method as in claim 1, wherein said theoretical amplitude density function P(r,n) is substantially represented by the equation: $P(r,n) = \frac{n!}{r!(n-r)!} \cdot p^r \cdot (1-p)^{n-r}$, where n and r are nonnegative integers, $r \le n$, n represents a theoretical total number of molecules on a surface of a virtual SAW sensor, r represents a theoretical number of molecules on an active zone

of said virtual SAW sensor, and where p is substantially represented by: $p = \frac{\mu_{\text{active}}}{\mu_{\text{total}}}$, where μ_{total} is the total area of said surface and μ_{active} is the area of said active zone.

3. A chemical sensor system comprising:

a chemical sensor that produces an oscillatory output signal responsive to adsorption of molecules of a chemical analyte by a primary surface of said sensor;

measurement means for measuring a plurality of frequency fluctuations of said oscillatory output signal;

amplitude density means, coupled to said measurement means, for generating an amplitude density signal representative of the amplitude density of said plurality of frequency fluctuations; and

decision means, coupled to said amplitude density means, for generating an analyte output signal representative of a total number n of said adsorbed molecules if said amplitude density signal corresponds to a theoretical amplitude density function P(r,n).

4. The chemical sensor system as in claim 3, wherein said chemical sensor is a surface acoustic wave (SAW) device.

5. The chemical sensor system as in claim 4, wherein said primary surface comprises at least one active zone.

6. The chemical sensor system as in claim 5, wherein said primary surface comprises a diffusion barrier that restricts diffusion of said chemical analyte to said primary surface.

7. The chemical sensor system as in claim 5, wherein said primary surface comprises at least one passive zone.

8. The chemical sensor system as in claim 4, wherein said chemical sensor further comprises a bandpass filter for selecting a single oscillatory mode.

9. The chemical sensor system as in claim 4, wherein said measurement means comprises a frequency fluctuation counter.

10. The chemical sensor system as in claim 9, wherein said amplitude density means comprises means for generating an amplitude density histogram of a measured time series of an output of said frequency fluctuation counter.

11. The chemical sensor system as in claim 4, wherein said decision means comprises a pattern recognizer for correlating patterns in said amplitude density signal to said theoretical amplitude density function.

12. A computer program product for use with a chemical sensor system including a chemical sensor arranged to produce an oscillatory output signal when exposed to a chemical analyte, said computer program product comprising:

a machine-readable recording medium;

a first instruction means, recorded on said recording medium, for directing said chemical sensor system to generate a fluctuation output signal in response to a plurality of frequency fluctuations in said oscillatory output signal, said fluctuations responsive to adsorption of molecules of said chemical analyte on a surface of said chemical sensor;

a second instruction means, recorded on said recording medium, for directing said chemical sensor system to generate an amplitude density signal representative of the amplitude density of said plurality of frequency fluctuations in response to said fluctuation output signal;

a third instruction means, recorded on said recording medium, for directing said chemical sensor system to generate an analyte output signal that identifies a total number n of said adsorbed molecules if said amplitude density signal corresponds to a theoretical amplitude density function P(r,n).

13. The computer program product as in claim 12, further comprising:

a fourth instruction means, recording on said recording medium, for directing said chemical sensor system to correlate patterns in said amplitude density signal to said theoretical amplitude density function.

14. The computer program product as in claim 12, wherein said theoretical amplitude density function P(r,n) is substantially represented by the equation:

$$P(r,n)=\frac{n!}{r!(n-r)!}\cdot p^{r}\cdot(1-p)^{n-r},$$ where n and r are nonnegative integers, $r \leq n$, n represents a theoretical total number of molecules on a surface of a virtual SAW sensor, r represents a theoretical number of molecules on an active zone of said virtual SAW sensor, and where p is substantially represented by: $p=\frac{\mu_{active}}{\mu_{total}}$, where μ_{total} is the total area of said surface and μ_{active} is the area of said active zone.

15. A method of analyzing a chemical analyte, said method comprising the steps of:

generating a surface acoustic wave across a surface of a structure;

transducing said surface acoustic wave into an oscillatory output signal;

generating a fluctuation output signal in response to a plurality of frequency fluctuations in said oscillatory output signal, said fluctuations responsive to adsorption of molecules of said chemical analyte on said surface;

generating an amplitude density histogram in response to said fluctuation output signal; and

generating an analyte output signal that identifies a total number n of said adsorbed molecules if said amplitude density histogram corresponds to a known amplitude density histogram.

16. The method as in claim 15, wherein said known amplitude density histogram is substantially represented by the equation: $P(r,n)=\frac{n!}{r!(n-r)!}\cdot p^{r}\cdot(1-p)^{n-r}$, where n and r are nonnegative integers, $r \leq n$, n represents a theoretical total number of molecules on a surface of a virtual SAW sensor, r represents a theoretical number of molecules on an active zone of said virtual SAW sensor, and where p is substantially represented by: $p=\frac{\mu_{active}}{\mu_{total}}$, where μ_{total} is the total area of said surface and μ_{active} is the area of said active zone.